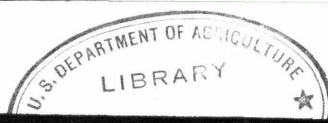


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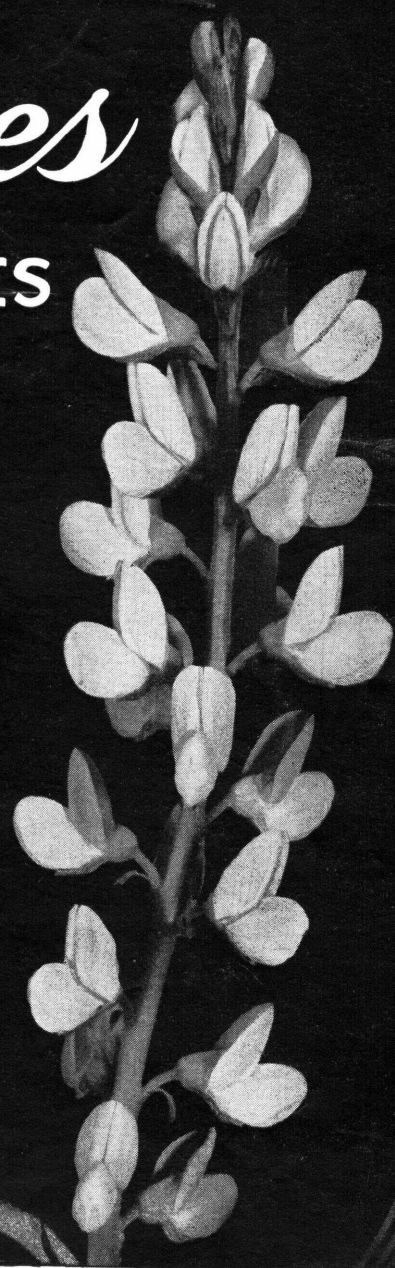
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# *Lupines*

## NEW LEGUMES FOR THE SOUTH

FARMERS'  
BULLETIN  
No. 1946



U. S. DEPARTMENT OF AGRICULTURE

# *LUPINES*

*A New Legume Crop  
for the Southern States*

## *Advantages:*

A valuable legume for winter cover crops and for green manure on account of its heavy yields.  
Does well on soils of low fertility.  
Stands are easily obtained.  
Produces abundant and easily harvested seed.

## *Requirements:*

Inoculate seed at time of seeding.  
Use superphosphate on soils of low fertility.  
Seed only deep enough for contact with moisture.

## *Precautions:*

Lupines, except the recently selected nonalkaloid varieties, contain an alkaloid poisonous to livestock.  
Do not allow livestock in lupine fields containing alkaloid varieties when other feed is not available.  
To avoid serious seed loss, harvest before plants are sufficiently ripe for shattering and dry seed immediately after harvest.



# Lupines: New Legumes for the South

By ROLAND MCKEE, senior agronomist, Division of Forage Crops and Diseases, Bureau of Plant Industry, Soils, and Agricultural Engineering, Agricultural Research Administration, and G. E. RITCHEY, agronomist, Division of Forage Crops and Diseases, and agronomist, Florida Agricultural Experiment Station

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## Nature and use of the lupine plant

**L**UPINES have been known since before the birth of Christ and for the past 200 years or more have been commonly used in central European countries for soil improvement and to some extent as feed for livestock. Of the many species recognized, the following annuals are the ones most used commercially: White lupine (*Lupinus albus*) ; yellow lupine (*L. luteus*) ; and blue lupine (*L. angustifolius*).

In New Zealand and Western Australia lupines have been used satisfactorily during recent years as feed for sheep, although they contain an alkaloid that is poisonous to many animals and thus reduces profits. Lupines containing alkaloid are called bitter, and nonalkaloid lupines, sweet.

In the United States in recent years plantings in the Gulf coast area have given good results, and extensive commercial plantings, chiefly of blue lupine (fig. 1), are now well established in Florida, Georgia, Alabama, and Louisiana. Lupines make excellent winter growth and heavy seed yields and are valuable as a winter cover crop to conserve soil fertility and to supply the nitrogen so much needed in crop production. While most of the acreage planted to lupines is in varieties having a high alkaloid content, nonalkaloid, or sweet, varieties have become established recently and, no doubt, will be increased.

### **Description and varieties**

The plants in nearly all species are upright and have coarse stems and medium-sized digitate (fingerlike) leaves. In thin stands they branch quite freely. In thick stands the blue and white species branch but little, while the yellow species usually send up a number of stems from a short central stalk or crown. Field-crop species are annuals; some ornamentals are perennials. Blue and white lupines usually attain a height of 2 to 3 feet, yellow lupines 1 to 2 feet (fig. 2). All three species are represented by sweet strains, but the blue sweet is the only sweet variety yet grown commercially in the United States. The yellow sweet, however, has done sufficiently well in experimental trials to suggest its early commercial use.

In the yellow and the white lupines the high-alkaloid and nonalkaloid strains can be distinguished by taste but not by appearance. In

**Figure 1.**—Blue lupines nearing full bloom in a large field planting.







Figure 2.—Single lupine plants—blue (left), yellow (center), and white (right)—showing general characteristics.

the white species, however, nonalkaloid plants seem to be much less vigorous than those with high-alkaloid content and make smaller growth. Aside from size, the plants are similar in appearance.

In the blue lupine, the nonalkaloid and high-alkaloid strains can, with limitations, be distinguished by outward appearance. This facilitates selection and will be helpful in maintaining the purity of va-

rieties. In general, pink flowers in the blue lupine are correlated with high alkaloid, and blue flowers with nonalkaloid plants. Blue-flowering plants high in alkaloid do occur, however, and selections of these have been put into experimental plantings. Plants with pink flowers and low alkaloid content have not been found. In the high-alkaloid strains of the blue lupine the pods remain straw color, while in the nonalkaloid strains they are much darker and become blackish gray. The color marking and general appearance of the seed offer some distinctions. These can hardly be described but are discernible to one familiar with the strains.

### **Keeping strains pure**

Most flowers of the blue, yellow, and white lupines are self-fertilized. It has been determined, however, that crossing varieties within species is possible and that it occurs to a limited extent under field conditions when varieties are in close proximity. There apparently is no crossing between species—all attempts at crossing have resulted in failure. Further, there is no evidence in plant characteristics to suggest species crossing.

Sweet, or nonalkaloid, strains have been artificially crossed with high-alkaloid strains within each species, and among the progeny are both alkaloid and nonalkaloid plants. This indicates the need for growing nonalkaloid strains in isolation and the necessity of careful supervision and roguing to keep strains pure.

### **Where adapted**

Lupines require cool weather for best development, and in the South commercial varieties must be grown as winter annuals. In the North they will have to be handled as summer annuals and seeded early in spring. Commercial plantings have succeeded in the United States in the Gulf coast area only. White lupine has done best on alluvial soil in the lower Mississippi Delta, and blue lupine on Coastal Plain soils farther east. Yellow lupine has not yet been grown commercially, although experimental plantings have given good results. Some soils are known to be better suited for lupines than others, but much remains to be determined regarding limits in soil adaptation. The northern limits of successful production remain to be determined.

### **Acreage**

It is estimated that 1,000,000 acres of lupines were formerly grown in Europe. Approximately 60,000 acres were planted in the United States in 1944, and about 8,000 were harvested for seed. In 1945 the acreage was increased to more than 14,000 for seed, with a total for all purposes of more than 200,000 acres.

### **Uses**

Lupines are used mostly for green manure. The large quantity of winter growth they produce makes them ideal for this purpose. Aside from large growth, the heavy nodulation of the roots adds a large amount of nitrogen to the soil, thereby making it possible to save substantially on fertilizer bills.

The upright habit of growth and the comparatively few plants required for a stand make lupines less suited for use in soil-erosion control than smaller and more matting types of plants.

Although immature plants of some species are eaten by livestock without harm, *a number of species are known to be poisonous*, both in the green and the dry state. The seed contains a higher percentage of poisonous alkaloids than any other part of the plant. Ordinarily livestock will not eat lupines containing poisonous alkaloids. The three species mentioned on page 1 normally have seed high in alkaloid.

The nonalkaloid strains recently developed in blue, white, and yellow lupines may extend the use of both fodder and seed as stock feed.

Some lupines are reported as good honey plants, but only limited information is available on their use for this purpose.

## **The Seed**

### **Characteristics**

The seed of white lupine is large, flat, and creamy white. That of blue lupine is roughly oval and dappled gray, and yellow lupine seed is flat and usually speckled white and black. Pure white and pure black seed strains, however, are known to exist in the yellow lupine and somewhat off-color types in both the white and the blue.

Seeds of all species, so far as known, retain their vitality under good storage conditions. White lupine has germinated 100 percent after 5 years and ordinarily has no hard seed; blue and yellow lupines often contain some hard seed. In the South, seed of blue lupine in a number of cases has deteriorated seriously in the second year but when dry at time of storage has retained germination well for 1 year. Seed of yellow lupine seems to retain its viability somewhat better than the blue, but good storage conditions and a low moisture content in the seed are necessary to insure good viability beyond 1 year.

White lupine has about 900 seeds per pound and weighs about 55 pounds per bushel; blue lupine has about 2,500 seeds and weighs about 60 pounds; yellow lupine has about 4,000 seeds and weighs about 60 pounds.

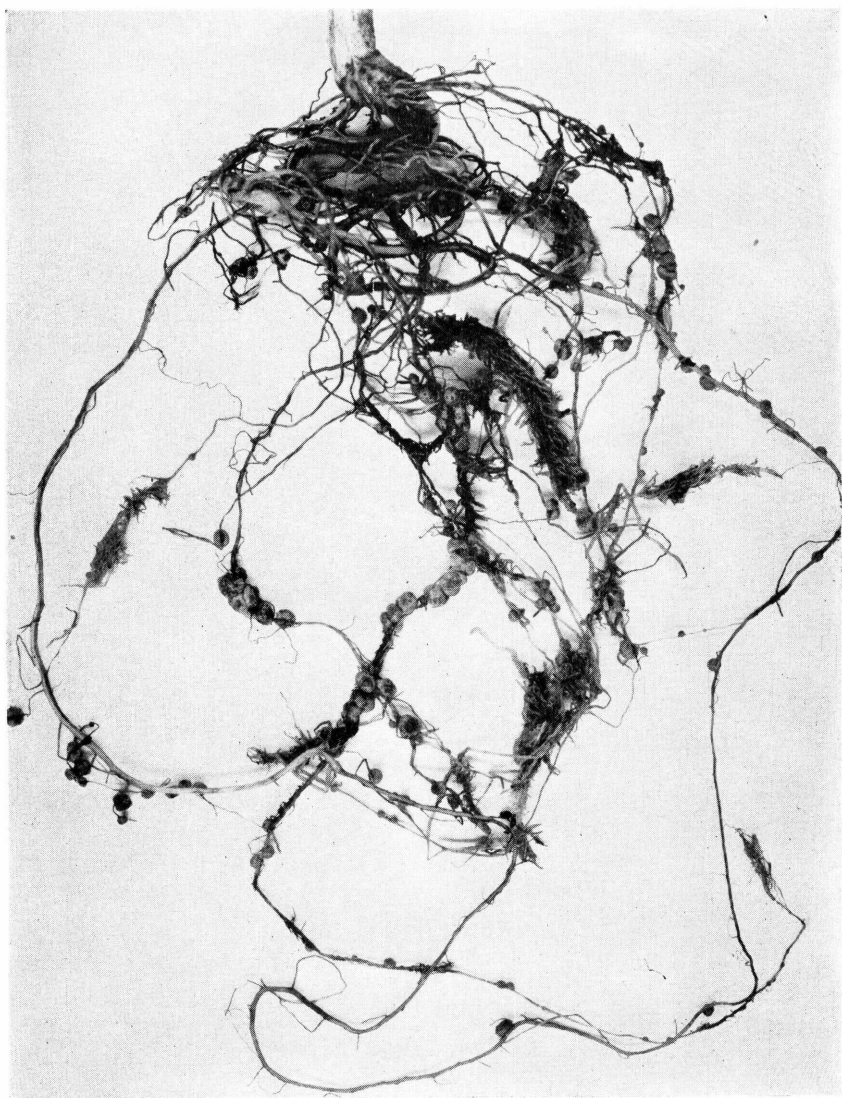
### **Source of supply**

Seed of most of the commercial species has been generally available from Europe. Blue lupine seed has been grown in Florida, Georgia, and Alabama and is now available in quantity through commercial seed firms.

## **Soil requirements**

Lupines differ in their adaptation to soils of different fertility levels. Yellow lupines do well on moderately acid light sandy soils of low fertility. Blue lupines require neutral or slightly acid soils of at least moderate fertility. White lupines need fertile neutral soils for satisfactory growth.





**Figure 3.**—Root of lupine, showing characteristic nodules, which contain nitrogen taken from the air and deposited through the interaction of bacteria.

## **Fertilizer**

The use of potash for lupines on sandy land has given negative results. Sodium nitrate has increased the yields but ordinarily is not needed. Superphosphate has given good results, and 300 to 400 pounds per acre is recommended unless the previous crops in the rotation have been heavily fertilized, in which case small quantities or none may be needed. Superphosphate has injured stands when applied in direct contact with the seed.

## **Lime**

On light sandy lands lime is considered detrimental to lupines or is not needed, but on heavier soils it may be beneficial.

## **Seeding**

### **Inoculation**

Inoculation of lupine seed is essential, and, so far as is known, it should be done every year. When the seed is well inoculated, nodules are produced in great abundance (fig. 3). Commercial cultures are available and should be used at the time of seeding.

### **Time**

In regions with mild winters (15° F. or above) seeding should be done from September 14 to October 15, if possible, although plantings can be made up to December 1. Later plantings sometimes give good results. Blue and yellow lupines volunteer some plants but cannot be depended upon to volunteer a full stand. Seeding in northern latitudes should be made early in spring (April 1 to May 15).

### **Rate**

Rates per acre to be recommended under average conditions when lupines are seeded in close drills or broadcast are as follows: White lupine, 160 pounds; blue lupine, 90 pounds; yellow lupine, 60 pounds. At this rate of seeding and with drills 8 inches apart, the seed in the drills would be about 4½, 3½, and 3 inches apart for white, blue, and yellow lupine, respectively. With favorable weather conditions and a good seedbed, these rates can be decreased about one-fourth.

### **Method**

A grain drill can be used, or the seed broadcast and covered by disking. Seed shallow, 1 or 2 inches deep, and firm the soil with a cultipacker or by other means to insure contact between the seed and moist soil. Seedings can be made in rows up to 3 feet apart without reducing seed yields, and sometimes this may be desirable.

## **Harvesting**

### **Season**

In the Gulf coast area of the Southeastern States, fall seedings mature in May or early in June. In northern latitudes early spring seedings mature in August.

## Green manure

In the South the comparatively large growth made by lupines during the winter months makes them an excellent crop for turning under for soil improvement. Where adapted, they make a heavier herbage yield than Austrian Winter field peas or hairy vetch and in this respect are superior to these crops, and following crops are increased accordingly. A 3-year average yield of more than 25,000 pounds green weight per acre by March 22 has been reported by the North Florida Agricultural Experiment Station, at Quincy, and is indicative of their high-producing ability.

A large taproot and its smaller lateral branches furnish an abundance of unusually large nodules that in turn supply nitrogen to the soil. This, together with the large quantity of organic matter that lupines supply and the fact that this is produced early, makes the plant a most desirable soil-improving crop to precede cotton, corn, or peanuts.

In vegetative growth the sweet blue and sweet white lupine selections seem to be less vigorous than the high-alkaloid strains of these species, while the sweet yellow selections seem to be entirely equal to the bitter strains of that species. On account of this lesser growth the sweet blue lupine varieties may not be so desirable for green manure as the bitter blue strains, although the sweet varieties make sufficient growth to serve well.

## Seed and yields

Lupines can be harvested and handled with ordinary farm machinery. *The high-alkaloid strains, which are the ones commonly grown, are not recommended for forage, however, because they might be poisonous to livestock.* When the nonalkaloid strains recently developed come into commercial production, the danger from poisoning can be eliminated. Under favorable conditions 1 to 3 tons of herbage per acre can be obtained from lupines.

Mature seed flails easily, making it possible for growers of small acreages to save seed for home use without special threshing equip-

Figure 4.—Harvesting blue lupine for seed with a combine in Florida.



ment. Most species produce seed abundantly. Blue lupines have averaged about 1,000 pounds per acre, with maximum yields about 2,000 pounds.

Lupine seed in all species ripens somewhat unevenly and contains a high percentage of moisture until thoroughly ripe. In order to save a maximum quantity of seed it is necessary to cut the crop with a mower or to harvest with a combine when the seed still contains considerable moisture (fig. 4). This means that harvesting should be begun before the plants are quite mature. When the seed is all ripe, cutting at night or when there is some dew will reduce shattering. Shattering of seed is greatest in the yellow lupine, least in the white, and intermediate in the blue. Just what the average moisture-content of the seed may be, as the crop is commonly handled, has not been determined, but it is known that it is so high that special care must be taken to dry the seed thoroughly after harvesting.

### Seed storage

From the limited information obtained it seems probable that some of the seed when harvested contained as much as 30 percent moisture. When stabilized to normal air-dry conditions the moisture will probably range from 12 to 14 percent. For safe storage, seed moisture after harvest should be reduced to 12 percent or lower as rapidly as possible. To reduce danger of damage by spontaneous heating, the newly threshed seed should be screened and the larger seed, which will contain the most moisture, separated from the drier seed and the two lots handled separately. One probably must learn from experience the proper stage of ripeness at which to harvest. In general, the riper the seed the less danger from deterioration, although the seed loss from shattering will probably be greater.

It has been determined experimentally that lupine seed loses moisture rapidly and that seed containing as much as 30 percent moisture 1 day may have little more than half that quantity the following day if it is exposed to free air circulation. Without good air circulation and good drying conditions, seed containing 15 percent or more moisture will deteriorate rapidly in ordinary summer temperature.

### Feeding value

The bitter, or high-alkaloid, varieties of lupine are recognized as inferior for feed on account of the danger of poisoning. They can be used, however, after soaking in water to remove the alkaloid, and this is sometimes done.

The feeding value of sweet lupines has not been definitely determined, but it is known that livestock will consume them and make relatively good gains when this is the entire feed eaten. They are reported in the *Journal of the Ministry of Agriculture, London*,<sup>1</sup> to give satisfactory results in feeding trials in New Zealand. In one feeding test lasting 23 days, yearling sheep on sweet yellow lupines

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<sup>1</sup> OLDERSHAW, A. W. SWEET LUPINS. [Gt. Brit.] Min. Agr. Jour. 51: 128-134. 1944.

gained 6.2 pounds in live weight; on sweet blue, 4 pounds; and on the bitter blue, 0.9 pound. In another experiment comparing sweet blue lupines with rape, lambs on 3 acres of rape gained 595 pounds and those on 3 acres of sweet blue lupines gained 1,068 pounds.

In England, mash composed of as much as 15 percent of meal made from lupine seed gave good results when fed to chickens; and pigs made satisfactory gains on feed containing 10 percent meal made from sweet blue lupine seed. Some German writers favor the sweet yellow lupine, which they consider as having higher feeding value than the blue, whether used green or dried or as silage or grain. In New Zealand the sweet blue variety is preferred, as in that country it makes better growth than the sweet yellow. Results of feeding trials in the United States are not yet available, but it seems likely that both the sweet blue and sweet yellow varieties can be used satisfactorily.

## Diseases

### Root knot

Lupines are subject to root knot (nematode), but suffer less damage than peas and vetch.

### Other diseases

Several fungus diseases sometimes do considerable damage to lupines. No definite control measures have been determined, but in Florida there has been less damage in the seedling stage from plantings made in November and December than from those made earlier. Selection for disease resistance is in progress. *Sclerotium rolfsii*, which attacks lupines, is also injurious to tomato, tobacco, and peppers. For this reason, lupines should not be rotated with these crops.

## Other information

Short statements on lupines are available in general reference books, and recently a bulletin<sup>2</sup> on the subject was published by the Florida State Agricultural Experiment Station. Many short articles on lupines have been published in European journals and American farm magazines.

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<sup>2</sup> WARNER, J. D. LUPINES, A SEED PRODUCING WINTER LEGUME. Fla. Agr. Expt. Sta. Press Bul. 541. 2 pp. 1939.

